Impacts of Lake Erie Harmful Algal Blooms on the Abundance and Growth of Larval Fishes and their Prey Resources

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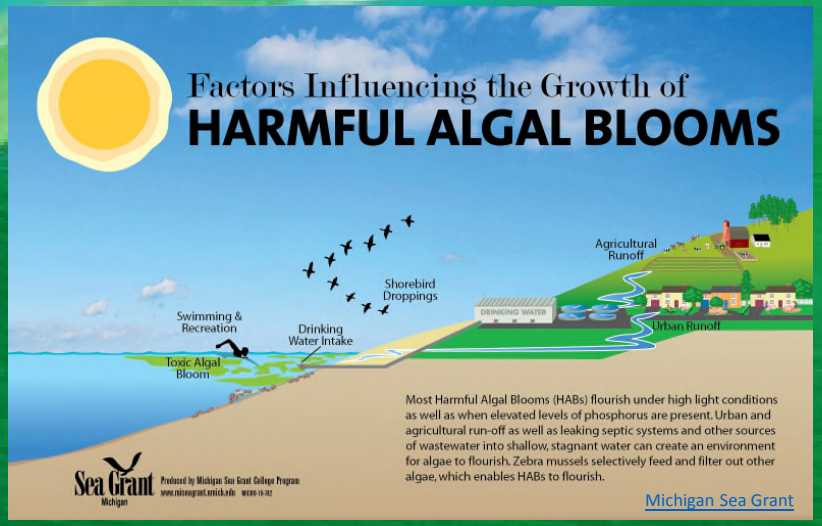
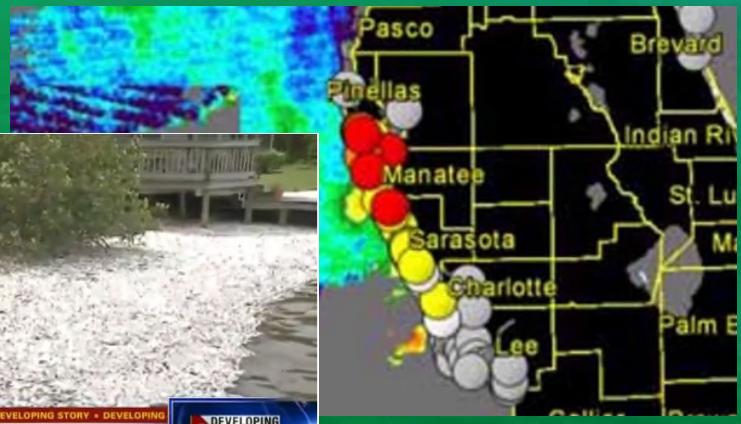
USGS science for a changing world

Harmful Algal Blooms (HABs)



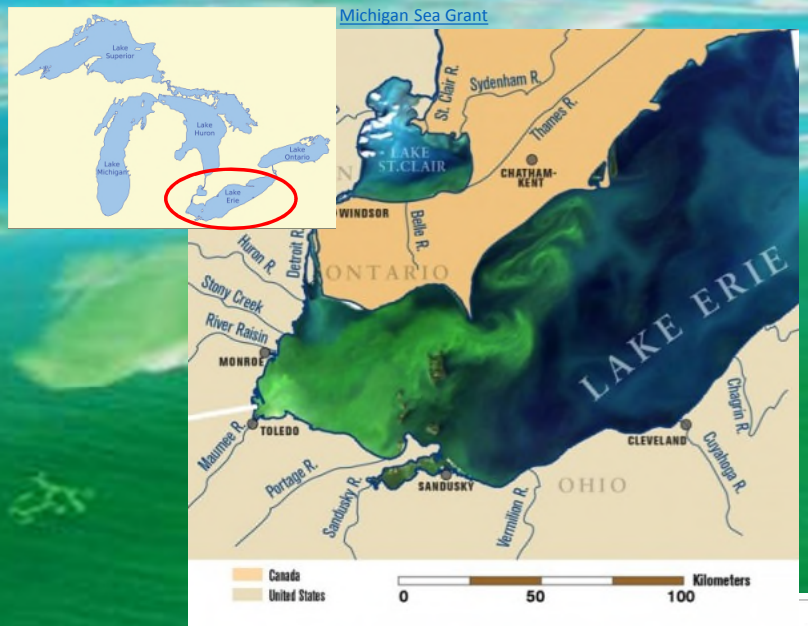
Michigan Sea Grant

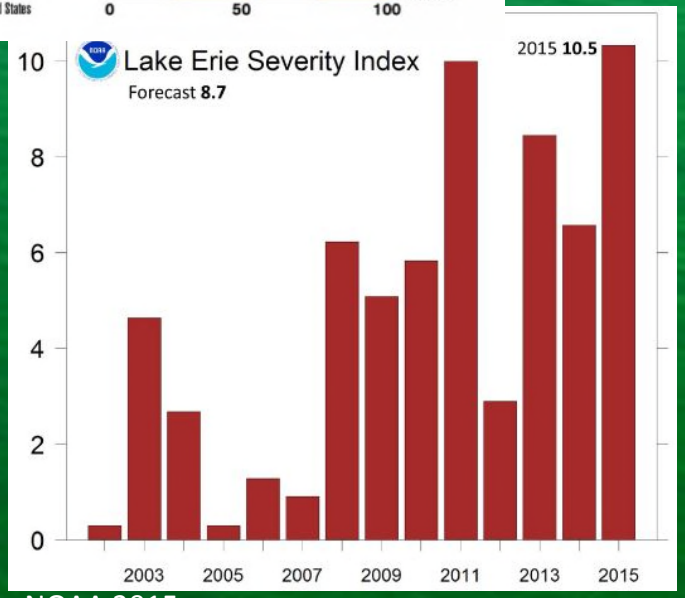


USF Red Tide Map
Fox 35

- HABs are a growing concern worldwide
- Link terrestrial and aquatic ecosystems
- Cultural eutrophication affects water quality and fisheries

Lake Erie HABs



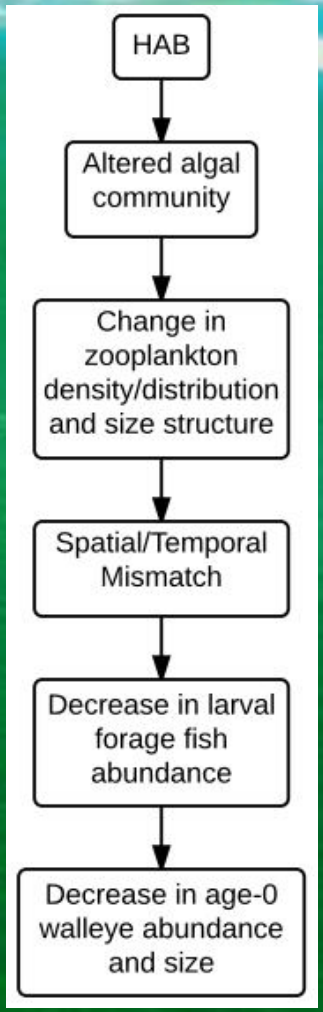


NOAA 2015

- 1960s-1970s: cyanobacterial blooms
- 1972: Clean Water Act,
  Great Lakes Water Quality Agreement
- Recent increase in frequency and intensity
  - 1995-2001: minimal HABs
  - 2002-2007: yearly moderate HABs
  - 2008-2015: yearly severe HABs
- Overlap with critical fish habitat in the western basin

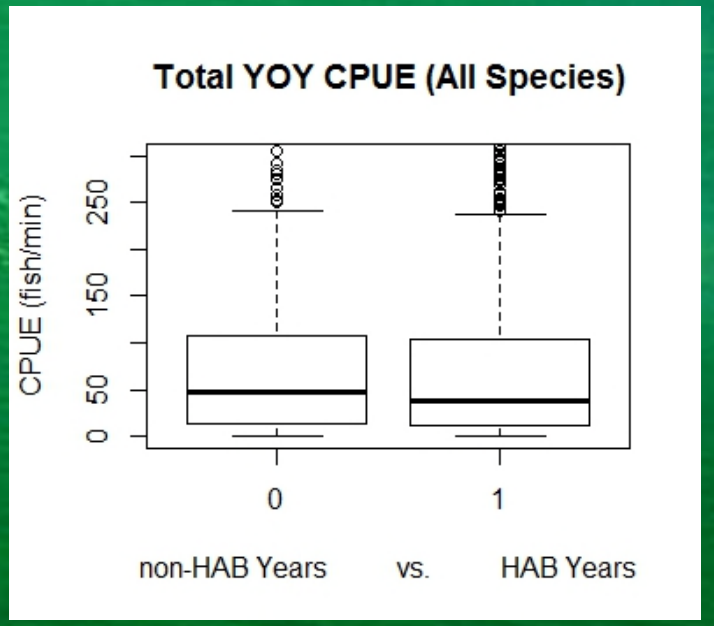
Research Hypothesis

- H: Lake Erie *Microcystis* blooms will decrease fishery recruitment indirectly by limiting the availability of suitable prey.
  - Specific focus on walleye, a keystone predator that supports a valuable fishery
  - Prey: Clupeids (alewife, gizzard shad), Notropis spp. (shiners), rainbow smelt
  - Linked to zooplankton indirectly through these prey fishes
  - Trophic cascade framework



Trends in YOY CPUE

- Fishery-independent bottom trawl survey to estimate year class strength
- Total CPUE was not significantly different HAB vs. non-HAB years



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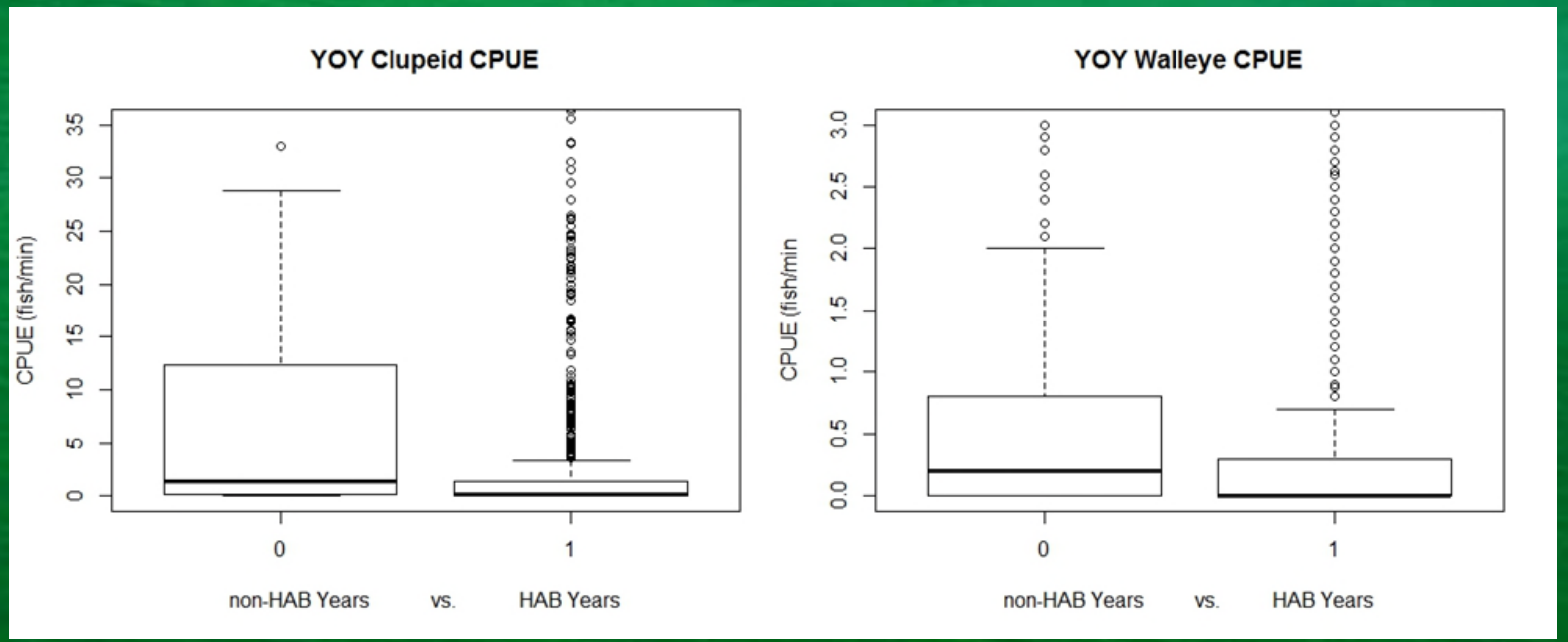
Trends in YOY CPUE

- HABs associated with lower clupeid and walleye CPUE



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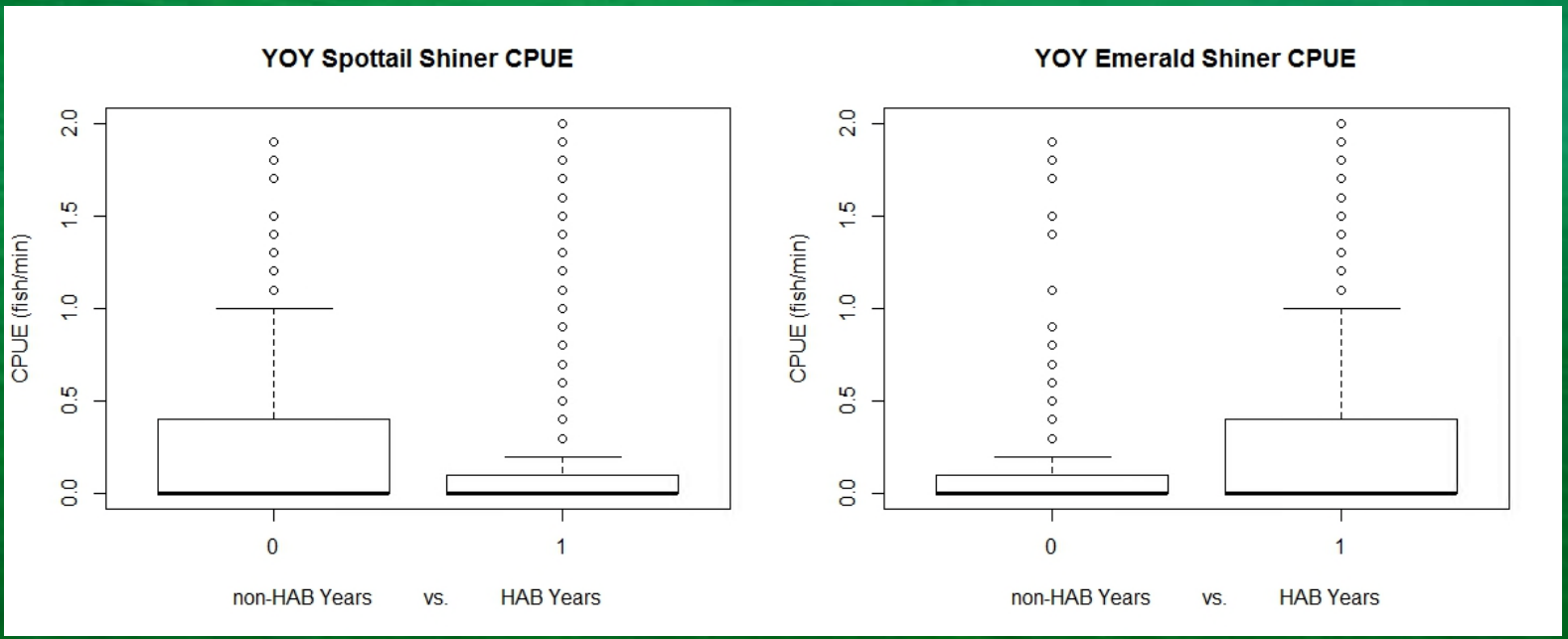
Trends in YOY CPUE

- Relationship between shiners and HABs depended on species



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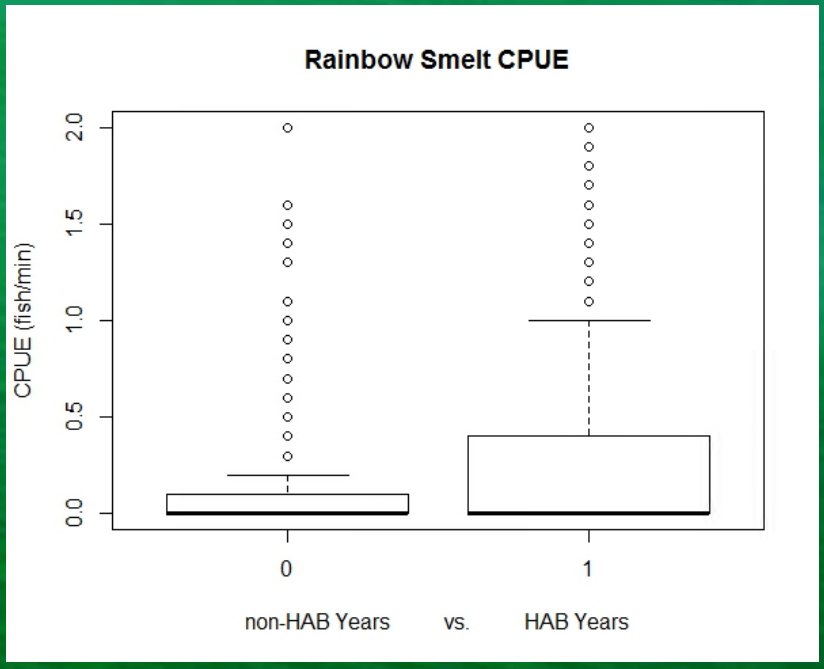
Trends in YOY CPUE

- Rainbow smelt CPUE was higher during HAB years



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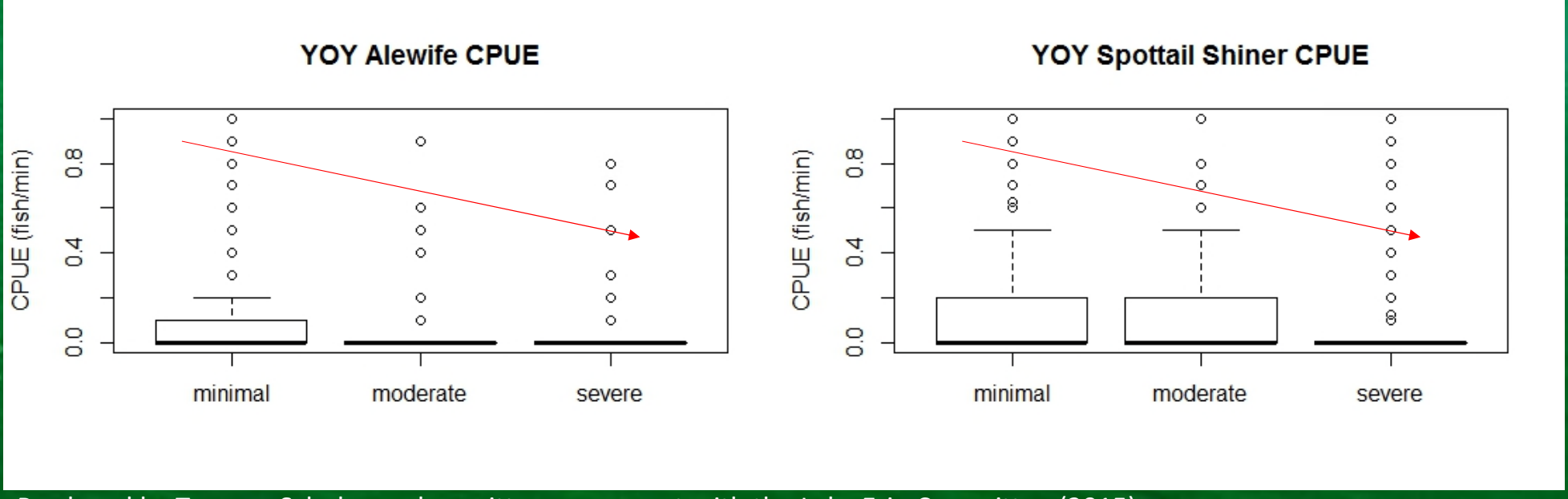
Trends in YOY CPUE

1995-2001: Minimal, 2002-2007: Moderate, 2008-2015: Severe

- Alewife, spottail shiner CPUE decreased with increasing HAB severity



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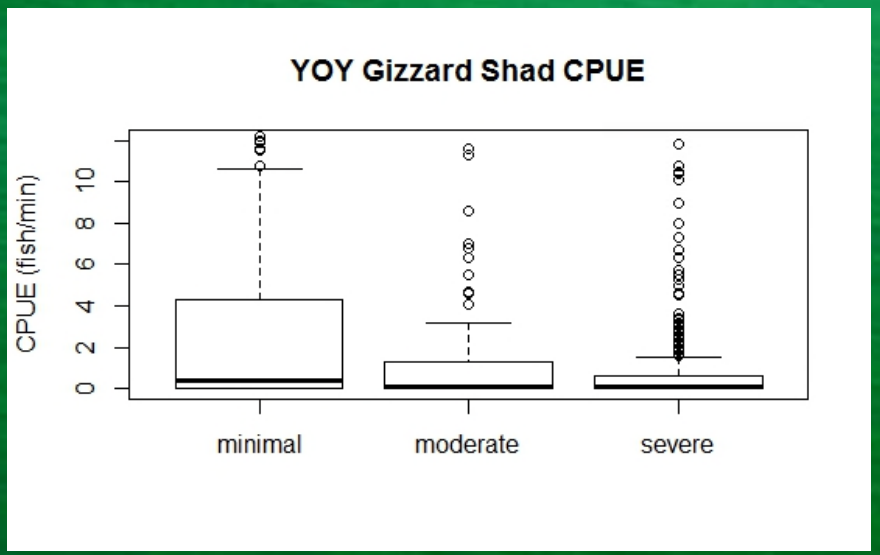
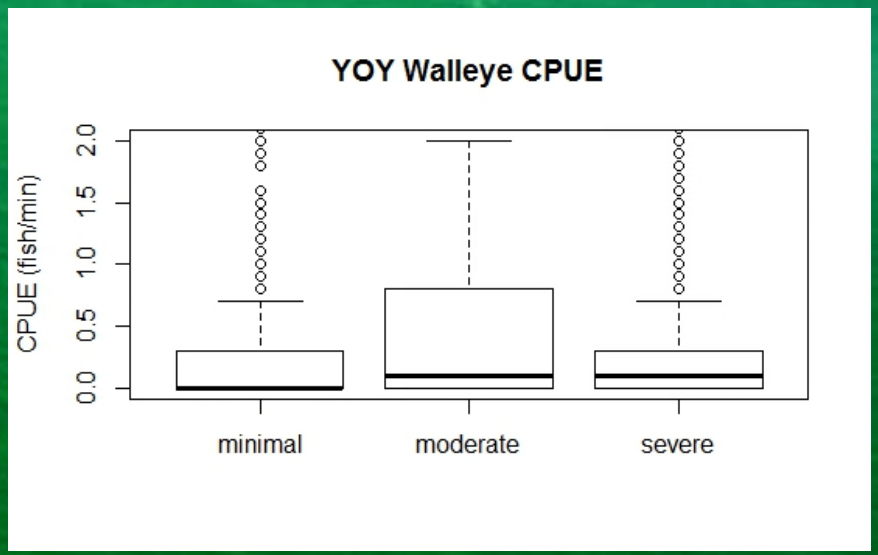
Trends in YOY CPUE

1995-2001: Minimal, 2002-2007: Moderate, 2008-2015: Severe

- Gizzard shad, walleye CPUE is highest during minimal HAB years





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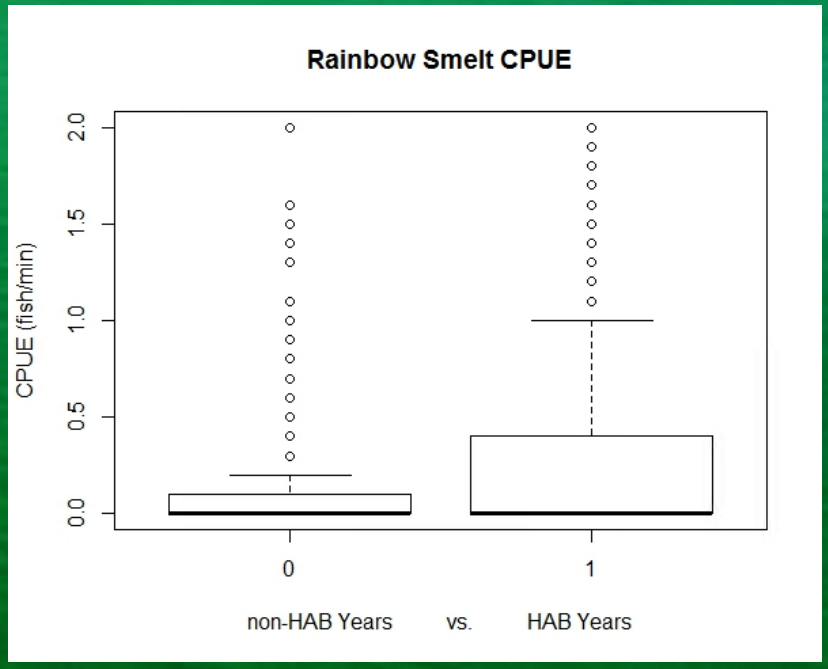
Trends in YOY CPUE

1995-2001: Minimal, 2002-2007: Moderate, 2008-2015: Severe

- Rainbow smelt CPUE is lowest during minimal HAB years



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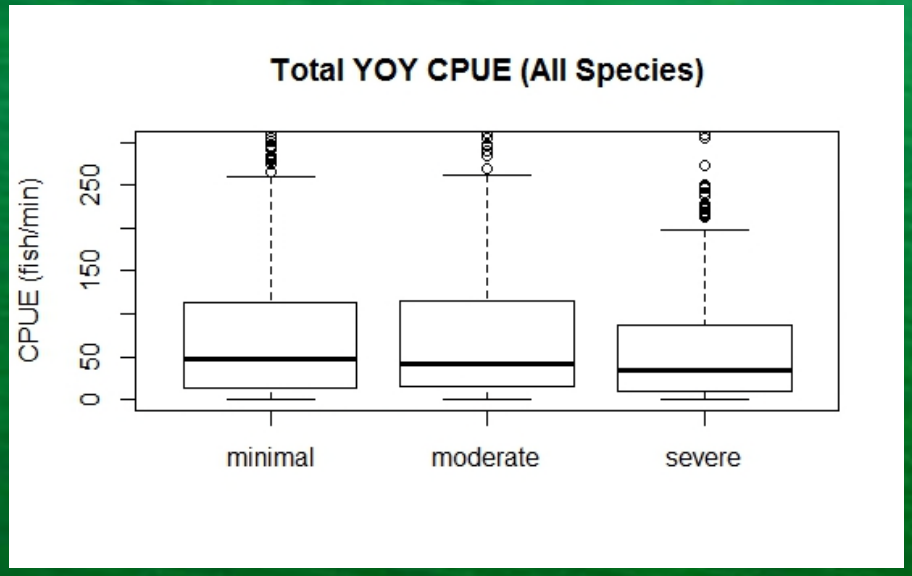
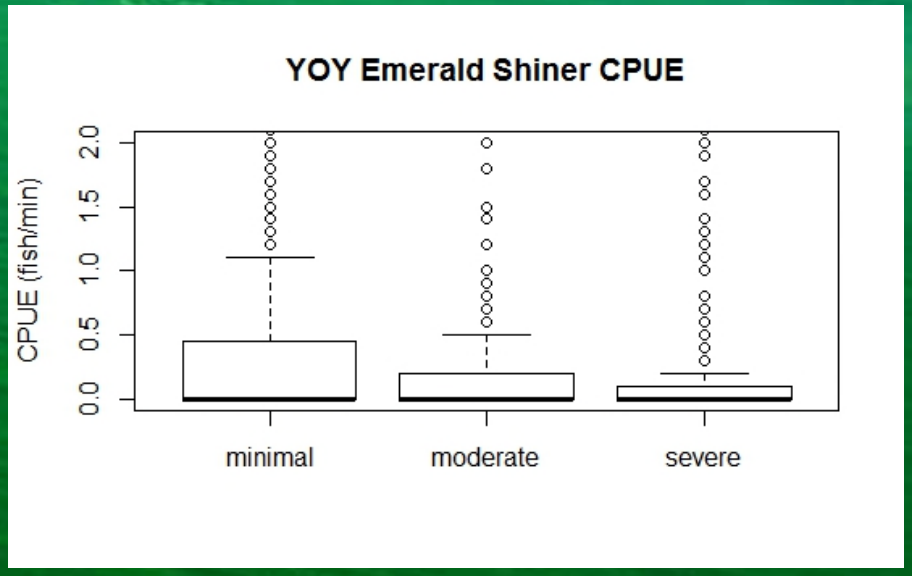
Trends in YOY CPUE

1995-2001: Minimal, 2002-2007: Moderate, 2008-2015: Severe

- Total CPUE, emerald shiner, mimic shiner is highest during moderate HABs





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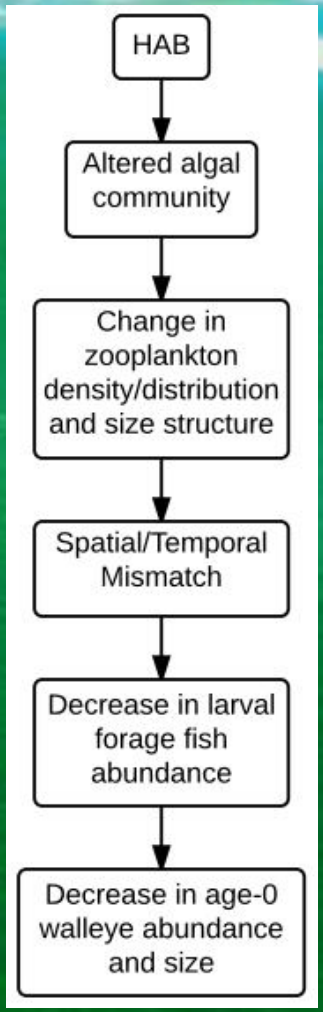
Trends in YOY CPUE

- Walleye may withstand moderate HABs, if they switch to less desirable prey (Clupeids → Notropis), and if there aren't too many consecutive HABs years

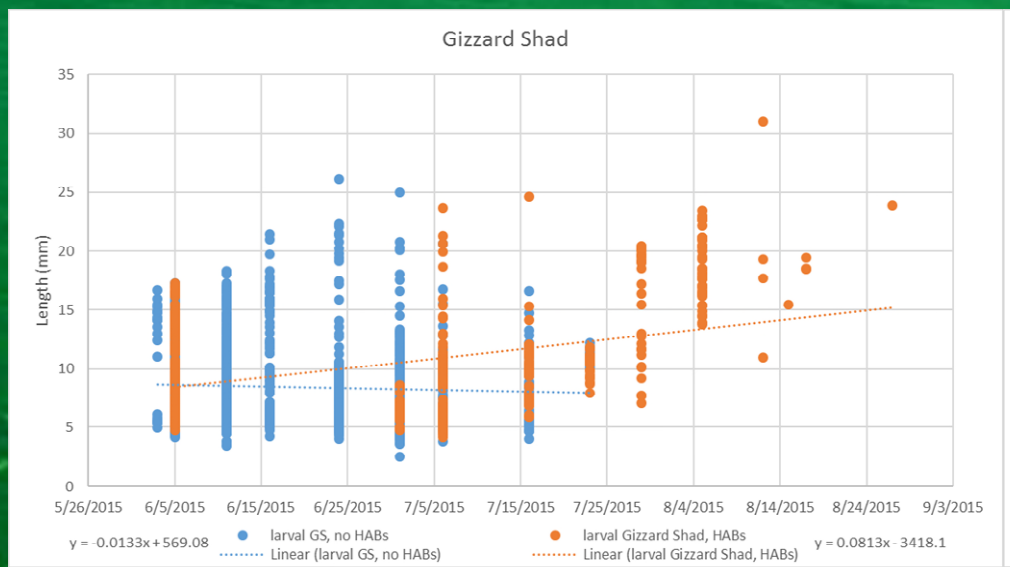


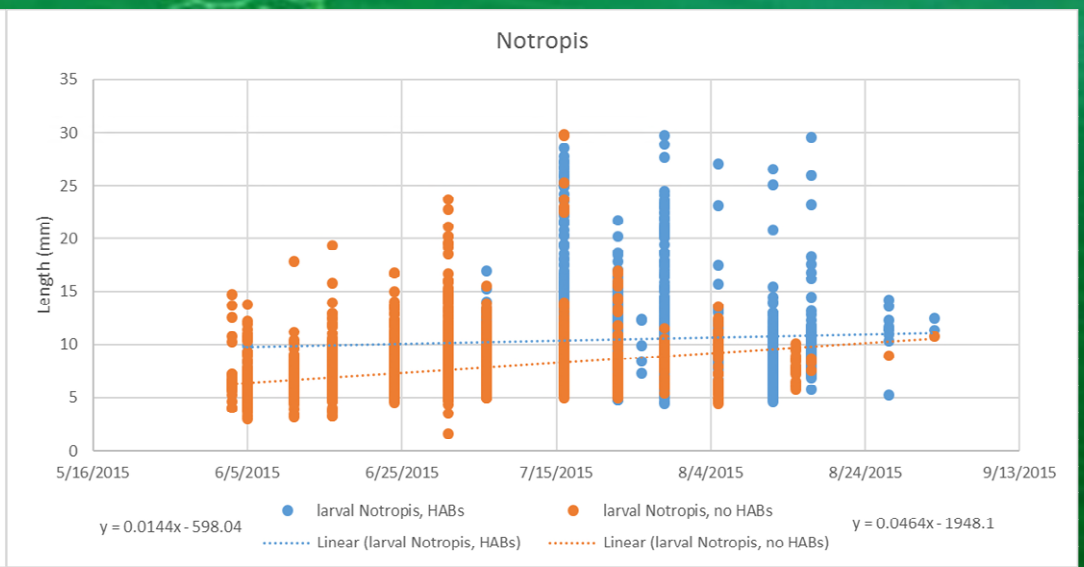
Trends in YOY length

- Length as a proxy for growth
- Alewife and gizzard shad were significantly longer in non-HAB years
- Emerald shiner, spottail shiner, rainbow smelt were longer in HAB years
- No significant difference in walleye length in HAB vs non-HAB years
- We see a decrease in YOY abundance (year class strength) because of decreased growth and survival during the larval stage

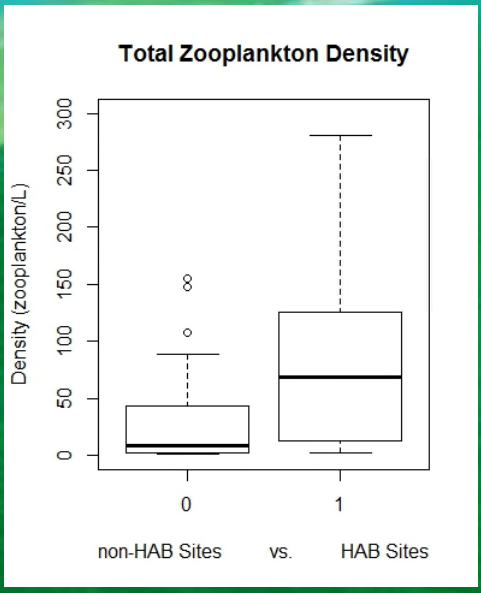
Trends in larval CPUE and length

- 2015 field study
- Total CPUE, gizzard shad, Notropis spp., and walleye CPUE were higher at sites without HABs
- No significant difference in walleye length at HAB vs non-HAB sites

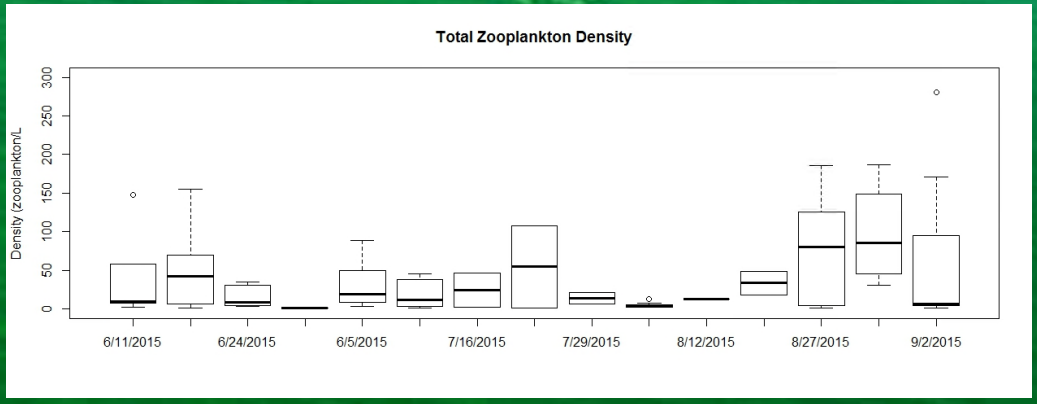




Zooplankton Trends

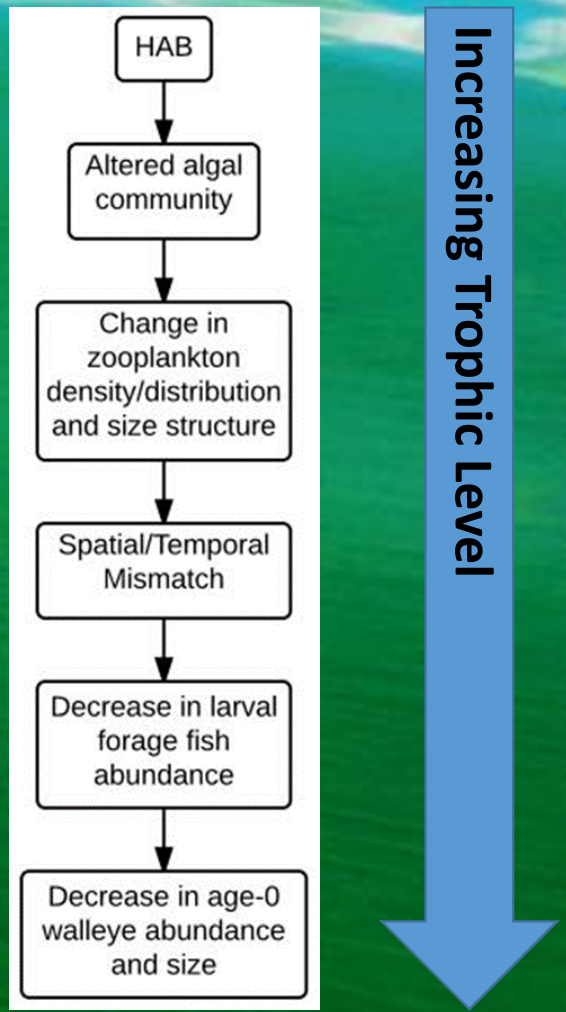


- Zooplankton density is higher at HAB sites
  - Copepod density was higher, no significant difference in Daphnia density
- Suggests larvae are not prey-limited during HABs



Summary

- Walleye YOY CPUE is lower during any HAB event because their preferred prey (clupeids) are less abundant
- Other prey items (Notropis) are available until HABs are consistently severe
- Larval CPUE (overall) is lower during HABs



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Acknowledgements

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Questions?